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Indian Standard

GUIDE ON MAINTAINABILITY OF EQUIPMENT

PART 8 MAINTENANCE AND MAINTENANCE SUPPORT PLANNING

Section 1 General

UDC 621·38·038 + 621·31 - 7 (026)

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Indian Standard
GUIDE ON MAINTAINABILITY OF EQUIPMENT
PART 8 MAINTENANCE AND MAINTENANCE SUPPORT PLANNING
Section 1 General

0. FOREWORD

0.1 This Indian Standard (Part 8/Sec 1) was adopted by the Bureau of Indian Standards on 17 August 1988, after the draft finalized by the Reliability of Electronics and Electrical Components and Equipment Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This guide is intended to make recommendations for the standardization of maintainability practices, and to stimulate ideas in the maintainability field. Organizations acquiring items will find the guide useful in assisting them in defining maintainability requirements and associated programmes. Item suppliers will benefit from the use of the guide, gaining an understanding of the requirements for achieving and verifying the maintainability objectives.

0.3 This standard (Part 8/Sec 1) is one of the series of Indian Standards on 'Guide on maintainability of equipment'. Other standards in this series are:

Part 1	Introduction to maintainability
Part 2	Maintainability requirements in specifications and contracts
Part 3	Maintainability programme
Part 4	Test and diagnostic procedures
Part 5	Maintainability design studies
Part 6	Maintainability verification
Part 7	Collection, analysis and presentation of data related to maintainability

0.4 This part (Part 8) of the series consists of the following four sections:

Section 1 General
Section 2 Maintenance support analysis
Section 3 Maintenance planning analysis
Section 4 Maintenance support resources requirements

0.5 In the preparation of this standard, assistance has been derived from the IEC Doc 56 (Central Office) 132 Draft IEC Publication 706 : 'Guide on maintainability of equipment Part 8 : Maintenance and maintenance support planning', issued by the International Electrotechnical Commission (IEC).

1. SCOPE

1.1 This standard (Part 8/Sec 1) describes general aspects related to planning for maintenance and maintenance support in design stage.

2. TERMINOLOGY

2.1 For the purpose of this standard, the terms and definitions as given in IS : 1885 (Part 39) - 1979* and IS : 7690 - 1975† shall apply.

3. GENERAL

3.1 It is generally recognized that a strong relationship exists between the areas of maintainability and maintenance. Achieving an item's maintainability goals during the operational phase is to a very large degree dependent on appropriate maintenance and maintenance support procedures and the provision of adequate maintenance resources. Efforts to reduce the active maintenance time by maintainability programme activities must be accompanied by a corresponding reduction of the nonactive maintenance time elements caused by technical, logistic and administrative delays. This implies adequate maintenance and maintenance support planning efforts by developing the maintenance concept, performing maintenance planning analyses (repair level analysis, identification and analysis of maintenance tasks) and determining the maintenance support resources requirements (personnel and training, technical manuals, test and support equipment, spare parts provisioning, facilities).

3.1.1 Maintenance and maintenance support resources have a major influence on the life cycle costs (LCC) of an item, which must be considered throughout the planning process. Maintainability and maintenance support planning tasks should, therefore, be closely coordinated and should be performed in an iterative manner.

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*Electrotechnical vocabulary : Part 39 Reliability of electronic and electrical items (*first revision*).

†Mathematical guide to the terms and definitions for reliability of electronic equipment and components (or parts) used therein.

3.2 It should be noted that the aforementioned activities are applicable to complex systems as well as to consumer products. However, the extent and depth of application of various tasks will vary greatly depending on the specific application. Maturity of technology, complexity and risks involved in not meeting operational requirements must be considered when selecting tasks for a particular application. The aim should be to select a minimum number of tasks which will satisfy the need. Owners may have their own support organization and systems with which new system/equipment shall be compatible. These constraints should be noted as part of the maintainability requirements.

4. PLANNING FOR MAINTENANCE AND MAINTENANCE SUPPORT IN THE DESIGN PROCESS

4.0 In order that a system can be efficiently placed in operation and maintained in the long term at optimum life cycle cost, it is necessary to plan maintenance and maintenance support activities and acquire the necessary resources in a timely manner. These activities start early in the concept and development phases and continue throughout the following life cycle phases. The objectives in planning the maintenance and maintenance support activities are as follows:

a) Develop a maintenance concept and make maintenance and maintenance support requirements an integral part of system requirements,

b) Determine the impact of the system maintainability design in terms of maintenance support requirements and optimize the maintenance concept,

c) Define maintenance support requirements and maintenance plan, and

d) Define the maintenance support required and specify the necessary resources.

4.1 Maintenance Concept

4.1.1 The development of new system/equipment starts with the definition of operational requirements. The development of maintenance concept which follows, provides the common basis for definition of maintainability requirements and for determination of maintenance support requirements which fit the design and satisfy its operational requirements. Development of maintenance concept is one of the most important steps in the system acquisition cycle and it initiates maintenance and maintenance support planning, responsibility for which may be separated from that for maintainability engineering.

4.1.2 The maintenance concept provides a general description of a plan for system/equipment maintenance and support in an operational environment. It describes the following:

a) Criteria concerning choice of lines and levels of maintenance,

b) Basic maintenance support (logistic) policies and requirements, and

c) Criteria for monitoring and test equipment (built-in, automatic, monitoring).

4.1.3 In order to optimize a design and achieve the lowest life cycle costs, the maintenance concept and maintainability requirements should be developed in parallel.

4.2 Maintenance Support Planning — The purpose of this task to develop the programme plan and the means to control and review the programme. A maintenance support plan should be prepared which describes the following:

a) Management structure and responsibilities for the maintenance support programme;

b) Interfaces with other engineering programmes and tasks : design, reliability, maintainability, human engineering, safety, standardization, etc. Interfaces with data produced by these tasks will also be described;

c) Means of reviewing the design from the maintenance support point of view;

d) Identification of each task, its extent and depth and how each task will be performed;

e) Methods by which maintenance support related requirements will be disseminated to designers, contractors and subcontractors, and

f) Methods and procedures for control of a programme and design review.

4.3 Documentation

4.3.1 Maintenance support planning tasks should be documented to provide the record of analyses performed and decisions made affecting maintenance support of system/equipment. This documentation will provide:

a) input into any subsequent analysis performed later in the system/equipment life cycle;

b) help to avoid duplication of tasks analyses;

c) database for input into procurement documentation for maintenance support resources; and

d) database of system/equipment maintenance support, and experience database for future projects.

4.3.2 The following documentation should be prepared and when specified by the customer, these documentation shall be submitted as part of the contract:

a) Definition of maintenance concept and constraints,

b) Maintenance support analysis plan,

c) Summary of use study and maintenance support system definition,

d) Analysis of maintenance support alternatives and evaluation,

e) Definition of the selected maintenance support system,

f) Specification of the maintenance support resources:
   1) Personnel and training,
   2) Technical manuals and software,
   3) Test and support equipment,
   4) Spare parts, and
   5) Facilities.

g) Assessment of maintenance support, and

h) Supporting data as required.

5. RELATIONSHIP BETWEEN AVAILABILITY, RELIABILITY AND MAINTENANCE SUPPORT

5.1 Availability is one of the system effectiveness parameters. While inherent availability is a function of its reliability and maintainability only, operational availability includes another parameter, maintenance support. Reliability and maintainability are system/equipment design attributes and maintenance is the result of unreliability, caused generally by design constraints. Maintenance support is needed for performing maintenance. Its effectiveness depends on maintenance personnel possessing the necessary skills and availability of the necessary maintenance support resources: technical manuals, spares, test equipments and facilities. The relationship between availability and reliability, maintainability and maintenance support are as follows:

$$\text{Inherent availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$$

$$\text{Operational availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR} + \text{MLDT}}$$

where MTBF (mean time between failures) is a measure of reliability,

MTTR (mean time to repair) is a measure of maintainability, and

MLDT (mean logistic delay time) is a measure of maintenance support.

5.2 System/equipment maintainability and maintenance support resources have direct effect on maintenance costs and have major influence on the life cycle costs (LCC) which must be considered throughout the planning process. Maintainability and maintenance support planning tasks should be closely coordinated and should be performed in an iterative manner. Table 1 Summarizes the objectives of maintenance support planning tasks and identifies requirements for coordination or direct participation in maintainability engineering tasks.

TABLE 1 MAINTAINABILITY-MAINTENANCE AND MAINTENANCE SUPPORT PLANNING INTERFACES

Maintainability Tasks Maintenance and Maintenance Support Planning Tasks	Requirement and Feasibility Analysis	Production Analysis	Maintainability Design Analysis	FMEA	Design Review Maintainability	Demonstration Test Design
Maintenance concept Repair level analysis, maintenance task analysis, maintenance plan	0	0	0	0	0	
Personnel and training	0	0	0	0	0	
Technical manuals	0		0	0	0	
Test and support equipment	0		0			
Spare parts	0			0		
Facilities	0		0	0		
Maintenance support demonstration						0

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